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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/530,678	04/08/2005	Hiroshi Sato	070120-0315226	7749

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EXAMINER	
LEADER, WILLIAM T	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
09/30/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/530,678	SATO ET AL.	
	Examiner	Art Unit	
	WILLIAM T. LEADER	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *4/08/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 3, 4, 5 and 8 are rejected under 35 U.S.C. 102(a) or 35 U.S.C. 102(e) as being anticipated by Mayer et al (US 6,402,923).

3. The Mayer et al patent (hereinafter Mayer) is directed to a method and apparatus for uniform electroplating using a variable field shaping element. Mayer recognizes that it is desirable to control the metal deposited on the substrate to be as uniform as possible. However, electroplating is susceptible to thickness nonuniformity due to causes such as the terminal effect (i.e., the potential drop across the substrate as distance from the electric terminal applying power to the substrate increases). See column 1, lines 59-67. Mayer shows in figure 2 a semiconductor wafer coated with a barrier layer 202 and a seed layer 200. This corresponds to the wafer shown in applicant's figure 3 with barrier layer 102 and seed layer 103. Mayer recognizes that during electroplating there is a significant potential difference between the center of the wafer and the periphery of the wafer (column 3, lines 4-7). This corresponds to applicant's disclosure that during electroplating the wafer has a larger current density in the peripheral portion than in a

center portion, which poses a problem of low plating uniformity in paragraph [0004] of applicant's specification. To compensate for the potential drop in the seed layer, Mayer provides a time variable field shaping element in the electroplating vessel. The shield of Mayer provides an inverse resistance drop in the electrolyte to achieve a uniform current distribution (column 4, lines 12-18).

4. As shown in figure 4 of Mayer, the apparatus includes a reservoir 402 for holding the treatment solution in which a substrate, which may be semiconductor wafer 412, is immersed. The apparatus additionally includes a first cathode electrode 408 in electrical contact with substrate 412, and a second anode electrode 406 disposed in reservoir 402. These elements of Mayer correspond to the solution tank, first electrode and second electrode recited in applicant's claim 1. Mayer further provides mechanical shield (diaphragm) 416 in reservoir 402 between the wafer and the anode 406 (column 5, lines 33-35). The diaphragm has a variable aperture 418. This shield corresponds to the diaphragm shown in applicant's figure 2 which also includes a central opening. Mayer teaches that the apparatus may include a mechanical drive mechanism to raise and lower the shield to vary the distance separating the shield from the wafer (column 4, lines 16-18). This drive corresponds to the position varying mechanism recited in applicant's claim 1. All elements recited in the apparatus of instant claim 1 and the method of instant claim 8 are taught by Mayer.

5. With respect to claim 3, the mechanical drive mechanism of Mayer functions to adjust a center portion of the shield or diaphragm.

6. With respect to claims 4 and 5, Mayer teaches that there is a need to move the shield in a continuous manner to offset the variable potential drop along the radial vector 422 which extends

from the edge to the center of the wafer. This movement is implemented by the controller 424 and central processor 426. As shown in figure 4, the controller also controls the application of current to the cathode electrode and the anode electrode. Since the variable potential drop changes as the degree of treatment (electroplating) occurs, controller 424 is necessarily responding to the degree of treatment sensed in some manner, such as elapsed time for example, in controlling the position of the shield.

7. Claim 7 is rejected under 35 U.S.C. 102(a) or 35 U.S.C. 102(e) as being anticipated by Reid et al (US 6,179,983).

8. The Reid et al patent (hereinafter Reid) is a method and apparatus for electroplating an electrically conducting layer onto substrates such as semiconductor wafers. Reid discloses that it is important that the conductive layer be deposited as uniformly as possible. Reid recognizes that in conventional electroplating processes, the deposit may be nonuniform due to factors such as the edge effect, where the deposited conductive layer is thicker near the wafer edge (where the electric terminal contacts the wafer) than at the wafer center (column 1, lines 38-48). The apparatus of Reid is illustrated in figure 1. The apparatus includes a treatment solution tank 42 in which a substrate is immersed. This corresponds to the tank recited in applicant's claim 7. The apparatus of Reid also includes power supply 60 which provides electric power to clamshell 32 in which the wafer is mounted and which serves as a first electrode, and to anode 62 which functions as a second electrode. These correspond to the first electrode and second electrode recited in instant claim 7. To overcome the nonuniformity in the deposited conductive layer, the apparatus of Reid additionally includes device 10, which Reid describes as a virtual anode. This

device has a series of openings which control both the electric current flux and the plating solution (column 5, lines 10-31). Virtual anode 10 corresponds to the diaphragm shown in applicant's figure 2 which is a mechanical device with openings. As shown in figures 1 and 2, virtual anode 10 of Reid has a portion facing a center portion of the substrate being positioned closer to the substrate than a portion of the virtual anode 10 facing a peripheral portion of the substrate. All limitations of applicant's claim 7 are met by Reid.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al (US 6,402,923).

12. Claim 5 and 8 recite that control of the diaphragm position is based on a measurement of the degree of treatment of the substrate. As noted above, Reid discloses utilizing controller 424 to position the shield (diaphragm) 416 to control the uniformity of the deposit which, since the treatment applied by Mayer is electrodeposition, is a measure of the degree of treatment. Should Reid be interpreted as not explicitly or implicitly teaching basing control on a result of a measurement, it would have been obvious to have measured a process parameter related to the amount of material deposited, and to have based control of the shield on this measurement because it was the amount of material deposited that the shield position of Mayer determines.

13. Claims 2 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al (US 6,402,923) in view of Reid et al (US 6,179,983).

14. Mayer et al and Reid et al are interpreted and applied as above. Claims 2 and 7differ from the apparatus of Reid by reciting that a center portion of the diaphragm is closer to the substrate than the periphery. As noted above, this feature is taught by Reid. The prior art of record is indicative of the level of skill in the art. It would have been obvious to have configured shield 416 in the apparatus of Mayer to be closer to the substrate in a center portion as taught by Reid because this configuration assists in making the deposit more uniform.

15. Claims 6 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al (US 6,402,923) in view of Warren et al (US 6,187,164) and the text *Electroplating* by F. A. Lowenheim.

16. Mayer is interpreted as applied as above. Claim 6 and 9 additionally recite plating on a substrate with a plurality of electrodes and controlling based on the current through each of the electrodes. The Warren et al patent (hereinafter Warren) is directed to a test substrate which includes an array of individually addressable electrodes. Figure 1A illustrates a test substrate with an array of 64 individually addressable electrodes. Warren recognizes that in electroplating the thickness of the deposited layer is controlled through electrical quantities such as current (column 1, lines 20-29).

17. Lowenheim also shows that thickness of the deposited layer is related to electric current. Lowenheim discloses that electroplating follows Faradays laws. As shown by the formula on page 13, the grams of substance reacting, which in an electroplating process is the amount of metal deposited, is directly related to current I and time t. The quantity of electricity flowing in an electroplating cell may be determined by reading an ammeter and using a watch. See pages 12 and 13. It would have been obvious to have based the operation of the shield controller in Mayer on current measured at a plurality of locations using a test substrate with individually addressable electrodes as taught by Warren because it is known that current corresponds to the thickness of the deposit, and measurement at a plurality of location would have allowed better control of plating uniformity by appropriate adjustment of the shield.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to WILLIAM T. LEADER whose telephone number is (571) 272-1245. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/William Leader/
September 22, 2009

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795